

REMARKS

Claims 1-3, 5 and 6 are pending in the present application. The limitations of claim 6 have been incorporated into claim 1. Claim 6 has been canceled. New claim 7 has been added. Support for the new claim can be found at paragraphs [0002] and [0036] of the present specification. Claims 1-3, 5 and 6 stand rejected.

Claim 1 stands rejected under 35 U.S.C. 102(b) or 103 (a) over U.S. Patent 5,962,169 to Angell et al.

Claim 1 has been amended to include the limitations of claim 6. With this amendment, Angell should no longer be available as a prior art reference.

Notwithstanding the amendment to claim 1, the invention disclosed by Angell et al. is fundamentally different from the present invention. The major differences are as follows.

First, the present invention employs an ionic liquid, and in this point, the present invention can be distinguished from Angell et al.

The "ionic liquid" described in the present invention is a pure substance composed of a sole component (not a mixture). This pure substance is the "molten salt which is in liquid form 'at ambient temperature'".

Specifically, as described in, for example, claim 2, the ionic liquid of the present invention contains an organic-molecule-derived cationic species. When coupled with an appropriate anion, such a cationic species forms an ionic compound having a melting point which is significantly low as compared with existing ionic compounds. Some even have melting points lower than room temperature, assuming the liquid form at ambient temperature. An ionic compound having a melting point lower than room temperature is a typical "ionic liquid," and the present invention makes use of the unique property—a very low melting point—of this ionic liquid. In this point, ionic liquids are quite different from known ionic compounds. Therefore, ionic liquids have been recognized as forming a compound group physicochemically different from other ionic compounds such as alkali metal cations and alkaline earth metal cations. In the present invention, through use of the "ionic liquid," rubber members are successfully imparted with a property that will never be imparted with any known ionic

compound.

In contrast, the substances disclosed in Angell et al. are not "ionic liquids" as described in the present invention. The Examiner called our attention to column 4, line 58 of Angell et al. But the true meaning at that portion is that a mixture of a polymer and a salt is in liquid form. In view that a pure substance and a mixture are chemically considered as completely different from each other, the ionic liquid of the present invention (which is a pure substance) and the ionic compound of Angell et al. (which is a mixture) belong to two different groups. Moreover, none of the salts disclosed by Angell et al. are liquid at room temperature. Angell et al. discloses ionic compounds having alkali metal or alkaline earth metal cations, such as Li^+ , Na^+ , Mg^{2+} , etc. Such ionic compounds containing alkali metal or alkaline earth metal cations raise the problems as mentioned in [0006] in the Background Art section of the present application, and thus cannot provide effects similar to those attained by the ionic liquid employed in the present invention.

Second, in the present invention, rubber and ionic liquid are essential elements, whereas according to Angell et al., their polymer compounds are not rubber. Thus, the present invention is not anticipated by the invention of Angell et al.

When undergone vulcanization, the rubber material employed in the present invention can be transformed into a rubber member useful in an electrophotographic sensitive member; a transfer drum or a transfer belt, which is employed in a transfer process; an intermediate transport belt; or a developing blade, a developing roll, or a charge-imparting roll, which is employed in a developing process (see claim 7 after amendment). In use, these rubber members are pressed under tribological conditions, which produces frictional force between the rubber member and its counterpart member. The rubber member is required to be formed with a soft material in order to mitigate damage which may otherwise be given to the counterpart member due to the frictional force. The rubber member will be deformed under the stress applied by the counterpart member. Moreover, since the rubber member or its counterpart member is in mutual sliding movement during use, the rubber member will continuously undergo a mechanical stress of deformation during pressure being applied and restitution upon removal of pressure. Since the rubber member must maintain its initial shape for a prolonged period of time so as to meet the requirements of expected functional characteristics, the material of the rubber member is desired

to exhibit a restitutive performance which quickly returns the pressure-deformed shape to its original shape. In order to realize a quick restitution, material exhibiting rubber elasticity must be employed. Thus, the present inventors have prepared a rubber material which is a three-dimensionally cross-linked product of a polymer material having a point of reaction (i.e., cross-linking point), and exhibits rubber elasticity.

By contrast, the polymer compounds disclosed by Angell et al. are PEO, PPO, and other thermoplastic resins, which do not have a point of reaction (i.e., cross-linking point) for enabling three-dimensional cross-linking to proceed. Also, according to this reference, addition of a substance (such as a sulfur compound, azo compound, or a peroxide) required for achieving a three dimensional molecular configuration is not performed, and any treatment to this effect; i.e., cross-linking treatment such as heating or irradiation with light, is not performed. In short, the polymer compounds disclosed in Angell et al. do not assume a three-dimensional molecular structure, and accordingly, it is hardly believable that they exhibit rubber elasticity.

Therefore, the term "rubber" used in Angell et al. should not be interpreted as such as a scientific term for a substance which exhibits rubber elasticity, but should be interpreted as indicating that the material is "rubbery," exhibiting properties similar to rubber. The terms "rubber" or "rubbery" appearing in Angell et al. indicate that resins such as PEO and PPO exhibit softness when compounded with an ionic compound. Since the substances referred to as "rubber" in Angell et al. does not exhibit rubber elasticity, which is an intrinsic property of rubber, the substance in question in Angell et al. is not a rubber.

Third, one essential characteristic required for the rubber member of the present invention is electric characteristics, which primarily include (i) ability to impart semi-conductivity (so-called moderately electric resistance of 10^3 to 10^9 Ω -cm or thereabouts), (ii) readiness to attain an intended electric resistance (i.e. easily controlled electric resistance), (iii) suppression of variation in electric resistance caused by environmental factors such as humidity changes (suppression of environmental dependency), and (iv) suppression of variation in electric resistance in response to variation in applied voltage (dependency on applied voltage). The present invention contemplates to obtain a rubber member meeting these characteristics.

In order to impart electric conductivity to generally nonconductive polymer material, two

methods are employed. One is to add a salt which are ionized and dissociated (called "ionic-conducting-type"), and the other is to add carbon black or metal having free electrons (called "electron -conducting-type"). When a rubber member is produced, electric conductivity is imparted through either method. However, using the ionic-conducting-type method, where a salt is added, characteristics requirements (i) and (iv) are satisfied but (ii) and (iii) are not sufficiently met. In contrast, using the electron-conducting-type method, where carbon black, etc. is added, characteristics requirement (iii) is satisfied, but (i), (ii), and (iii) are difficult to be satisfied. Thus, each of the ionic-conducting-type method and the electron-conducting-type method has its advantages and disadvantages, and up until the present invention, all the four electric characteristics required for the mentioned rubber members had been difficult to satisfy simultaneously. According to the present invention, as demonstrated in respective test examples in the specification, the above characteristics (i) to (iv) have been simultaneously satisfied through use of an ionic liquid.

In Angell et al., the "ionic compounds" are conventional ones having an alkali metal or alkaline earth metal species, such as LiClO_4 , as a cationic species. Although such ionic compounds may satisfy the above requirements (i) and (iv), the remaining requirements (ii) and (iii) cannot be satisfied concomitantly. (See the Comparative Examples in the specification).

Therefore, as stated above, the rubber member of the present invention is absolutely different from the corresponding material disclosed in Angell et al. with respect to any of constitution, effect, and purpose.

Claims 1-3, 5, and 6 stand rejected under 35 U.S.C. 102(b or e) or 103 (a) over Murphy et al. (US 2002/00100291 or Schmidt et al., (US 2006/0100323), or Boussand et al., US 2004/0116615). Each of these references fails to teach, disclose or suggest the present invention.

In Murphy, the ionic liquid is used as a catalyst for producing polyisooxolefine (see [0009] in Murphy) or as a reaction medium (see [0010] in Murphy). Usually, catalysts and reaction media are removed from the reaction system after reaction is complete; in Murphy, the ionic liquid is removed. In fact, Murphy describes, from lines 9 to 12 in [0058], that the produced polymer (polyisooxolefine) is separated from the catalyst.

On the other hand, the rubber member of the present invention employs an ionic liquid as a conductive agent, and the ionic liquid is positively and intentionally added so as to ensure conductivity. Therefore, the final product contains an ionic liquid.

Since Murphy fails to disclose that the final product contains an ionic liquid, it is believed that an ionic liquid is not present in the final product, which means that the present invention is not anticipated by Murphy, and the invention disclosed by Murphy does not suggest the concept of the present invention.

Boussand employs an ionic liquid as a solvent for a catalyst used in the production of a hydrogenated unsaturated block copolymer (see [0020] in the specification of Boussand). Usually, catalysts and solvents thereof are removed from the reaction system after reaction is complete; in Boussand, the ionic liquid is removed.

On the other hand, the rubber member of the present invention employs an ionic liquid as a conductive agent, and the ionic liquid is positively and intentionally added so as to ensure conductivity. Therefore, the final product contains an ionic liquid.

Since Boussand fails to disclose that the final product contains an ionic liquid, it is believed that an ionic liquid is not present in the final product, which means that the present invention is not anticipated by Boussand, and the invention disclosed by Boussand does not suggest the concept of the present invention.

Schmidt et al. US2006/0100323 was published on May 11, 2006, that is to say after the present invention was filed. Therefore, Schmidt US2006/0100323 cannot be used as a reference which rejects the patentability of the present invention under 35 U.S.C. 102(b).

Schmidt et al. US2006/0100323 is an international application, which was published in German, and not in the English language (WO2004/005391). Therefore, Schmidt US2006/0100323 cannot be used as a reference which rejects the patentability of the present invention under 35 U.S.C. 102(c).

Conclusion

Based on the Amendments and Remarks above, Applicant respectfully requests allowance of all pending claims.

Respectfully submitted,
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